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(54) **Image data processing apparatus having functions of dividing the image data, and method of processing image data**

(57) The image data processing apparatus comprises a camera (S2) for converting an image of an area to be processed into image data, a function (S3) of dividing the image data into divisional image data items corresponding to divisional areas obtained by dividing the divisional areas, and a function (S4) of performing pre-determined processing for each of the divisional image data items, thereby to detect an abnormal state of the area to be processed.

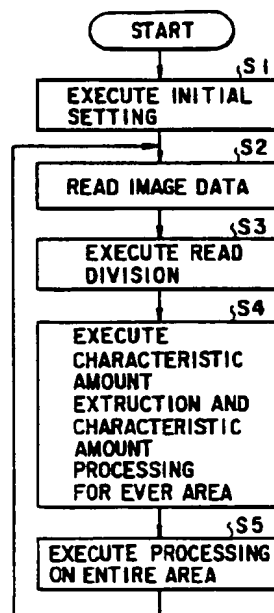


FIG. 7

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## Description

The present invention relates to an abnormal state detect method and an abnormal state detect apparatus, for monitoring an image within a monitor area with use of an image pick-up means such as an ITV camera, to detect an abnormal state in an image, and an abnormal state detect apparatus.

For example, in case where an image pick-up means is used to monitor an image within a monitor area, a consecutive difference of images inputted to be consecutive on the time base or a difference between an image and a background image. Then, the result is subjected to binary processing, to extract candidates of change areas which are considered to be caused by a movement of an object or the like.

In this case, areas where an object does not spatially exist are previously checked from placement conditions of an ITV camera, and data concerning such an object which has been previously recognized as will sure to enter into the monitor area is previously stored as a template. A change area which is too small among the extracted change areas is considered as noise and is removed, while the other remaining candidate areas are subjected to comparison with a template. If any of the areas is similar to the template, it is determined that the change of the area has already been recognized. If there is not an area similar to the template, the change of the area is a change which has not been previously recognized, and therefore, determined as an abnormal state.

Further, in several cases, this apparatus is applied to a paper material dealing apparatus or the like which classifies stocks, mails, and the likes by conveying them through convey paths. This card material dealing apparatus conveys postcards through convey paths, thereby classifying the paper materials, depending on their classifications, and paper materials to be dealt with are moved through substantially fixed lines previously predetermined. These paper materials sometimes derive or fall from the convey paths, due to accidents; due to abnormal states, e.g., bending or break-down of the paper materials or due to environmental changes. However, if an abnormal state detect apparatus is placed on a convey path, such abnormal states can be detected.

A conventional abnormal state detect method is, however, easily influenced by noise caused by vibrations of an ITV camera or the like, and influences from such noise appear when a differential binary image between images is obtained. Therefore, there is a problem that any noise removing processing must be provided.

In addition, it is necessary to previously provide information concerning the position where an ITV camera is placed. Further, when extraction is performed from candidate areas obtained as a result of differential binarize processing, comparison with a number of templates corresponding to objects which can occur in an image must be carried out. Therefore, there is a problem that the number of calculations tends to increase.

Further, since many kinds of templates are required with respect to object which can occur in order to make determination based on the shape of an change area when whether a change occurring is caused by a factor of an abnormal state or is included in a regular state is determined, there is a problem that it is not easy to distinguish a regular change from an abnormal change state.

In addition, when this apparatus is applied to a paper material dealing apparatus as described above, an operator must periodically carry out a complicated inspection as to whether or not an ITV camera is placed a monitor or area, whether or not there is a defective in the abnormal state detect function.

The present invention has an object or providing an image data processing method and an image data processing apparatus capable of detecting changes and abnormal states in an image at a high speed, without comparison with templates.

The present invention has another object of providing an image data processing method and an image data processing apparatus capable of automatically setting a position of a detection area and diagnosing a detect function, without an operator.

The present invention provides an image data processing apparatus comprising: means for continuously receiving a image of a first area to be processed, and for converting the image into a first image data item; means for dividing the first image data into a plurality of second image data items corresponding to a plurality of second areas which are smaller than the first area; and means for performing predetermined processing for each of the second image data items so as to determine an abnormal state in the first area.

The present invention further provides an image data processing method according to the first embodiment comprising: an inverting step of continuously receiving an image of a first area to be processed, and of converting the image into a first image data item; a dividing step of dividing the first image data into a plurality of second image data items corresponding to a plurality of second areas which are smaller than the first area; and a detecting step of performing predetermined processing for each of the second image data items, thereby to determine an abnormal state in the first area.

Further, the present invention provides an image data processing apparatus comprising: means for continuously receiving an image of a first area to be processed, and for converting the image into a first image data item; means for dividing the first image data into a plurality of second image data items corresponding to a plurality of second areas each of which is smaller than the first area; means for generating a recognizable mark in the first area at a predetermined timing; and means for detecting the mark generated by the means for generating a mark, thereby to determine that an inverting function of the image data processing apparatus regularly operates.

As described above, according to the image processing apparatus and method of the present invention, an image to be processed is divided into a plurality of images, and predetermined processing is performed on these divisional images, thereby to determine whether an abnormal state (or a change) is included in the image. Said predetermined processing means, for example, processing of determining that an abnormal state occurs in an image if the average density of an image or a time-based change in the characteristic amount of a dispersion value is a predetermined value or more. Due to this processing, an abnormal state can be detected by merely detecting changes in the characteristic amounts, so that processing for comparing an image with image templates as is used in a conventional apparatus is not required any more. As a result, the processing time can be greatly reduced. In addition, vibration of a camera is absorbed, and therefore, countermeasures for noise is not necessary any more.

In addition, according to the invention as described above, a recognizable mark is generated (e.g., by an LED) in the area of an image to be processed, and this mark is recognized and determined by an image pick-up system. As a result of this, an operator need not carry out complicated preparation for detection as to whether or not an abnormal state exists in the functions of the image pick-up system, unlike in a conventional apparatus.

Further, according to the present invention, if programs are arranged such that self-diagnosis processing for the image pick-up system is automatically carried out, a defect can be detected early unless an operator positively carries out diagnosis.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a block diagram schematically showing the structure of an abnormal state detect apparatus according to an embodiment of the present invention.

FIG. 2 is a view showing an example of a monitor environment and placement of an ITV camera.

FIG. 3 is a view which explains processing for dividing an input image into a plurality of areas.

FIG. 4 is a view which explains how parameters of areas are provided.

FIG. 5 is a view showing an area dividing method.

FIG. 6 is a view showing changes in characteristic amounts of an input image and areas.

FIG. 7 is a flow-chart which explains the entire processing.

FIG. 8 is a flow-chart which explains processing in an area level.

FIG. 9 is a flow-chart which explains the processing in the entire areas.

FIG. 10 shows examples of time-based changes of characteristic amounts.

FIG. 11A and 11B explain an example of the manner in which characteristic parameters are decided.

FIG. 12 is a flow-chart which explains the entire processing of an abnormal state detect apparatus

according to a second embodiment of the present invention.

FIG. 13 shows an example of a time-based change of a characteristic amount such as noise.

FIG. 14 explains an example of area division.

FIG. 15 shows an example of a time-based change of a characteristic amount which does not include substantial changes.

FIG. 16 shows an example of area fusion.

FIG. 17 is a flow-chart which explains division processing of areas.

FIG. 18 is a flow-chart which explains fusion processing of areas.

FIG. 19 is a flow-chart which explains fusion processing of areas.

FIG. 20 schematically shows a structure of a paper material dealing apparatus according to a third embodiment of the present invention.

FIG. 21 is a block diagram of an example of a structure mainly showing a processing device according to the third embodiment.

FIG. 22 explains a specific example of a mark generating section.

FIG. 23 explains another specific example of a mark generating section.

FIG. 24 is a flow-chart which explains self-diagnosis processing of an image pick-up system.

FIG. 25 is a block diagram of an example of a structure mainly showing a processing device according to a fourth embodiment of the present invention.

FIG. 26 explains an specific example of a false abnormal state generating section.

FIG. 27 is a flow-chart which explains self-diagnosis processing of a detect function.

FIG. 28 shows an example of placement of a mark within a set monitor area according to a fifth embodiment of the present invention.

FIG. 29A to FIG. 29C explain how a mark is viewed in a picked up image.

FIG. 30A is a flow-chart explaining an operation for setting a monitor area.

FIG. 30B is a flow-chart explaining an operation for setting a monitor area.

In the following, embodiments of the present invention will be explained with reference to the Drawings.

A first embodiment of the present invention will firstly be explained below.

FIG. 1 schematically shows the structure of an abnormal state detect apparatus according to the first embodiment. Specifically, an ITV camera 10 as an image pick-up means is placed, for example, as shown in FIG. 2, and images within a monitor area E as shown in the figure are continuously picked up, and converted into electric signals. Image signals (analog signals) outputted from the ITV camera 10 are inputted into an A/D converting section 21, and are digitalized by sampling pulses of a predetermined sampling rate outputted from a sampling pulse generating section 22. The signals thus digitalized are sequentially stored as image data into an

image memory 23. These input images can be recognized by displaying them on a display device 13, and also, can be inquired layer if these input images are recorded and stored by a recording device 24 such as a video tape recorder or the like.

A processing section 25 is constituted mainly by a CPU, and performs processing as will be described later on a plurality of images (e.g., two images) taken in on the time-base by an image memory 23, thereby to achieve processing for extracting an abnormal state from the images. If it is determined that an abnormal state occurs, the processing section 25 makes an alarm device 26 to operate to notify an operator or the like of the abnormal state, while the processing section 25 makes the recording device 24 record images preceding and following the image determined as including an abnormal state, and makes those images displayed on the display device 13, so that an operator can confirm the abnormal state.

The processing section 25 divides an input image (of  $M \times N$  pixels) as shown in (a) on FIG. 3 taken in by the image memory 23 into a plurality of areas, such that each of the area has an equal defined by uniformly dividing an input image in the longitudinal and lateral directions (e.g., by  $m$  and  $n$ , respectively). The areas thus divided respectively have their numbers with respect to the total number of the entire areas, and their coordinate values of left upper and right lower corners, as parameters (see FIG. 4).

With respect to division of areas, there is a method in which areas do not overlap each other as shown in (a) on FIG. 5 and another method in which areas partially overlap each other. Although each of divided areas have been explained as having a size equal to each other, the size of such an area which should particularly be monitored finely may further be divided into a number of small areas, and thus, it is possible to change the size of the divided areas if necessary. In this case, areas must be assigned to the entire image.

To actually process an image, an input image at each time is divided into a plurality of areas as has been explained above, and each of the areas is subjected to the processing as will be explained below. Although division of areas has been explained to be performed such that each of divided areas has a rectangular shape, the shape of an area is not limited to a rectangle in any cases.

In the following, detailed explanation will be made to time-based changes in characteristic amount in each divided areas and processing for extracting an abnormal state.

FIG. 6 shows an example in which an input image is divided into a plurality of areas, and thereafter, an abnormal state is extracted on the basis of time-based changes in the characteristic amount in the divided areas. This figure shows an area which includes a change in accordance with changes in characteristic amounts within the divided areas. The flow of this processing will be explained with reference to a flow-

chart of the entire processing shown in FIG. 7. In FIG. 6, (a) to (d) show input images, while (e) to (g) show changes in characteristic amounts of areas corresponding to the input images.

At first, with respect to each of divided areas, time-based changes in characteristic amount is set as a parameter in initial setting (S1). Next, an input image converted into digital image data at each of time points is taken in (S2), and the input image thus taken in is divided into a plurality of areas (S3). With respect to each of the area, any characteristic amount included in each image is calculated (S4). In each of the areas, changes in characteristic amount up to the time point are compared with a parameter supplied to the area, presence or absence of an abnormal state is checked for every area (S4). In the next, results of processing of respective areas are integrated, and presence or absence of an abnormal state is checked with respect to the entire areas. If it is determined that an abnormal state occurs, notification is performed (S5).

Here, an average density value of an image, a dispersion value, and a confusion (complication) using a result of differential binarization may be used as the characteristic amount included in each divided area. In case of a color image, each color phase, a chroma, a brightness may be used.

If an average density value or a dispersion value are used as the characteristic amount, an average value within an area is once obtained and a dispersion value is calculated again, according to a normal dispersion value calculation method. However, if an taking-in interval between images is short and the processing speed is high, it is considered that a change in an image pick-up view field between consecutive image is not relatively large, so that it is possible to obtain a dispersion value with use of an average value at a preceding time point, i.e., to use a so-called false dispersion value.

In the next, the processing of extracting an abnormal state at respective area levels in the step S4 in the flow-chart of FIG. 7 will be specifically explained with reference to the flow-chart shown in FIG. 8.

A characteristic amount  $d(t)$  is extracted sequentially for every of the divided areas (S11), and a difference  $d(t-1)$  between the extracted characteristic amount at a preceding time point is obtained. If it is determined that a change exists by threshold value processing (S12), the characteristic amount is compared with a parameter (S13). If the characteristic amount exceeds a predetermined threshold value as a result of comparison with an allowable range of the parameter (S14), it is determined that the change in characteristic amount is caused by an abnormal state, i.e., an abnormal state exists in the corresponding area (S15). This processing is performed on all of the areas.

Note that the threshold value used for extracting a change as described above and a threshold value of an allowable range of a parameter may be experimentally set with use of a result obtained by previously checking changes in characteristic amount with use of a test

image, or may appropriately be obtained such that changes in characteristic amount can be extracted in the procedures of processing steps.

Examples of such threshold values will be explained below.

In FIG. 10, (a) is taken as an example of a time-based change in characteristic amount within each area. In this case, six parameters are considered as shown in FIG. 11A, e.g., a value (B) where the amount is stable, a height (H) when a change occurs, a continuation period (L) for which a change is maintained, and errors  $\beta$ ,  $\eta$ , and  $\lambda$ .

These parameters may be determined by investigation a result obtained by analyzing image data within a monitor area E, or may be determined from a result obtained by arranging a processing system so as to have a learning function and making the processing system to perform learning such that a time-based change in characteristic amount can be appropriately extracted as described above.

Six examples shown in FIG. 10, (b) to (g) are supposed as time-based changes in characteristic amount in this area.

On (b) in FIG. 10, the change is remarkable at a starting period, and the amount soon returns to an original stable state. Therefore, this change is simply considered as noise.

On (c) in FIG. 10, the entire shape and the continuation period are substantially equal to those of the above case, but the height of the peak exceeds the allowable range. Therefore, this change is considered as an abnormal state.

On (d) in FIG. 10, the change is remarkable at a starting period, and the amount returns to an original state after a time period substantially equal to a continuation period. In this state, the change is similar to a parameter previously prepared, and is therefore considered as a regular change.

On (e) in FIG. 10, the change is remarkable at a starting period, and the amount once decreases before the continuation period ends. Then, the amount returns to the height of the peak, and finally, returns to an original state after a time period substantially equal to the continuation period. This is a change similar to a parameter previously included, and is therefore considered as a regular change.

On (f) in FIG. 10, the change is remarkable at a starting period, and the continuation period starts. However, the amount changes over the height of the peak. The change thus differs from a parameter previously included, and is therefore determined that any abnormal state exist.

On (g) in FIG. 10, the change is remarkable at a starting period, and the continuation period starts. However, the amount does not return to an original state after the continuation period. Therefore, there is a possibility that something is staying in the corresponding area, so that it is determined that an abnormal state exists.

As explained above, if a change which is determined as an abnormal state exists in changes in an area, it is determined that an abnormal state is present in the corresponding area.

Note that the six parameters as described above may be supplied for all of the areas, supposing that any change occur in all of the areas. However, parameters other than B need not be supplied for those areas which have previously been recognized as including no changes, since parameters other than B are not necessary for such areas. Further, in case where an object which cyclically moves (e.g., an object conveyed on a belt conveyor of a conveyor system) is monitored, another parameter  $S(\pm\sigma)$  may be supplied as an occurrence interval between changes.

In the above explanation, a rectangular wave which changes in the positive direction is used as an example of a time-based change in characteristic amount. It is needless to say that corresponding processing is performed in other cases.

Next, processing of extracting an abnormal state at the entire area levels in the step 5 in the flow-chart shown in FIG. 7 will be specifically explained with reference to the flow-chart shown in FIG. 9.

After the processing for each area is completed, to whether or not the processing for the entire areas is necessary is checked (S21). If the processing for the entire areas is necessary, results of areas in the periphery of an area indicating an abnormal state among the entire areas are investigated (S22). If there is another area including an abnormal state (S23) in the periphery of the area indicating an abnormal state, whether or not there is further another area indicating an abnormal state in the periphery of said another area is checked (S24), in the same way. If there is an area indicating an abnormal state, these areas are combined with each other (S25). In this state, if the areas indicating an abnormal state exist isolated from each other, the size of an area changing is too small, the abnormal state is considered as noise (S26).

If the number of elements when areas indicating an abnormal state are finally combined each other exceeds a predetermined threshold value (S28) after presence of an abnormal state is thus checked with respect to the entire areas (S27), the group of those areas is determined as an abnormal area (S29), and it is determined that an abnormal state exists in the image. A notification is then performed by stopping processing. Even if the predetermined threshold value is not exceeded, any measure is taken for attracting an attention.

The following methods are considered as a method of determination as to whether or not the processing should be performed with respect to the entire areas in the step S21. Specifically, as described above, occurrence of an abnormal state is checked for each area, and thereafter, searching for an abnormal state is performed on the entire areas where one of the following conditions is satisfied.

(1) As a result of performing processing of each area, one or more areas indicating an abnormal state exist.

(2) The ratio of the number of areas determined as including an abnormal state to the number of the entire areas exceeds a predetermined value.

Note that, if the processing speed is high, each of changes in the image pick-up view field is not considered as large, and it is therefore possible to obtain a dispersion value with use of an average value at a preceding time point, i.e., a so-called false dispersion value, without using a normal calculation method of obtaining once an average value within an area and then calculating a dispersion value again, when a dispersion value is calculated.

In the next, a second embodiment will be explained.

The second embodiment is different from the first embodiment in that the processing (S5) for the entire areas, which is performed in the first embodiment, is not carried out, and instead, area division and fusion processing (S6) are performed, as shown in the flow-chart of the entire processing in FIG. 12. The area division and fusion processing will be specifically explained below.

At first, processing of area division will be explained. As shown in FIG. 13, a time-based change in characteristic amount within a divided area shows a noise-like state, it is determined that noise always exists in the corresponding area. To prevent such determination, each of the divided areas is further divided into small areas, so that time-base changes in characteristic amount can be monitored.

Specifically, with respect to areas in an image, if a time-based change in characteristic amount within an area is similar to noise as shown in FIG. 13, if the frequency of occurrences of changes is high, and if this state continues for a predetermined time period or more, the area is further divided.

With respect to this processing of area division, explanation will be made with reference to the flow-chart shown in FIG. 17. After extraction of characteristic amount  $d(t)$  is completed with respect to each of areas divided in the step S4, a difference between the amount and a characteristic amount  $d(t-1)$  at a preceding time point is obtained, and it is determined that a change occurs if the difference data is larger than a threshold value  $T_s$  (S31). The number of times for which the change occurs is calculated. If this change continuously exists and the number of times for which the change occurs exceeds a predetermined threshold value  $T_{cs}$  (S33), area division is performed (S34).

As a result of this, since parameters are not previously set with respect to those areas which are newly added by the area division, parameters of the areas before this area division are assigned to those areas (S35). In the next, the number of times (Cs) for which a change occurs is reset (S36), and the flow goes to the next processing.

In the area division in the step S34, for example, division as shown in FIG. 14 is performed. In this step, an division is performed such that an area is divided into four equal small areas. A number of a new area and coordinate values of the left upper and right lower corners are assigned, for example, as parameters to each of the divided areas. In addition, depending on the division method of the initial state, areas may be divided so as to have an overlapped portion or not to have an overlapped portion (see FIG. 5).

In the next fusion processing of areas will be explained. In case where time-based changes in characteristic amount in an area are not substantially observed as shown in FIG. 15, with respect to areas in an image, such changes occur at a low occurrence frequency, and this state continues for a predetermined period or more, fusion with an area which is in a similar state in the periphery of the area is performed.

This processing of area fusion will be explained with reference to the flow-chart shown in FIG. 18. After completion of division processing of the above described areas, a state counter for counting absence of changes counts "+1" (S41). Then, a difference between the characteristic amounts  $d(t)$  and  $d(1-t)$  extracted as described above is obtained. If the difference data is larger than a threshold value  $T_m$  (S42), it is determined that a change occurs, and the state counter is reset (S43). The flow goes to processing of a next image.

When a state where no changes exists continues and the count value of the state counter exceeds a predetermined threshold value  $T_h$  (S44), attribute information added to an area is rendered "fusion"-possible (S45). All of the areas are checked, and thereafter, fusion processing is performed (S46).

Area fusion processing in the step S46 will be explained with reference to a flow-chart shown in FIG. 19. At first, all the areas are subjected to searching (S51), attribute information of areas is read (S52), and whether or not fusion is possible is checked (S53). If fusion is possible, attribute information of close areas is checked as to whether or not fusion is possible (S53). If fusion is possible, parameters of an area being processed are provided for an area to be fused (S55). With respect to areas on which fusion has already been performed, attribute information is returned to a normal state, and this operation is performed on all the areas (S56 and S57).

In fusion of areas, fusion is performed as shown in FIG. 16, for example. In this case, fusion of areas is carried out such that a new area becomes rectangular again. Specifically, three close areas, i.e., an area adjacent to the target area in the right side thereof, an area below the target area, and an area below the adjacent area in the right side of the target area are checked.

In the above, area division and fusion processing have been explained. However, if changes occur at a low frequency with in an area, with respect to each of areas in an image, it is possible to reduce the entire processing amount by reducing the number of times for which

processing is performed on related areas, without performing fusion processing as described above.

In addition, if the number of areas changes by repeating division and fusion of areas, replacement of numbers of areas is performed if necessary. Replacement of the numbers of areas is performed, for example, in a method of checking the coordinate value of the left upper corner which each area has as a parameter in the order from the left upper area to the right lower area in an image, thereby assigning numbers thereto.

Although the above explanation has been made to a case in which fusion processing is performed subsequently after division processing of areas is performed, the processing may be performed in a reverse order, or the division processing of areas and the fusion processing areas may be performed in parallel.

In the following, a third embodiment will be explained with reference to the drawings. The third embodiment is an example in which an abnormal state detect apparatus according to the present invention is applied to a paper material dealing apparatus, and in which a self-diagnosis function is supplied by a mark.

FIG. 20 schematically shows the structure of a paper material dealing apparatus according to the present invention. Specifically, a supply section 1 supplies paper materials P such as stocks, mails, or the like, one after another. Paper materials P thus supplied are conveyed by a convey path 2, and distributed into branch convey paths 4 and 5 through a distribution gate 3 provided at a rear end portion of the convey path 2. Compilation sections 6 and 7 are respectively provided at rear end portions of the branch convey paths 4 and 5, so that conveyed paper materials P are compiled and stored.

Note that a determination section 8 for determining the kinds of paper materials P by optically reading image information on the paper materials P is provided in the middle of the convey path 2, and the distribution gate 3 is switched and controlled in accordance with determination results of the determination section 8.

Meanwhile, an ITV camera 10 is provided at each of specific positions of the convey paths 2, 4, and 5 (i.e., within ranges in which an abnormal state is estimated to occur). For example, a predetermined range of a position of a distribution gate 3 is set as a monitor area 9, and an ITV camera 10 an image pick-up means for picking up an image within the monitor area 9 is provided.

An image signal picked up by the ITV camera 10 is sent to a processing device 12 through a transmission path 11, and processing for detecting abnormal convey of a paper material P is performed. When abnormal convey is detected, an alarm device not shown is operated, or a figure or a letter indicating an abnormal state is displayed on a display device 13.

FIG. 21 is a block diagram of an example of a structure according to the third embodiment, and mainly shows the processing device 12. This embodiment shows a case in which a self-diagnosis function is provided for an image pick-up system. The basic structure of this embodiment is the same as that of FIG. 1, and

therefore, only those portions of the structure which are different from the structure of FIG. 1 will be explained below.

A detect processing section 25 mainly comprises, for example, a CPU and the like. This processing section 25 performs differentiate calculations on a plurality of images (e.g., two images) taken in by an image memory 23 on the time base, and extracts a change area between consecutive images on the time-base which are stored in the image memory 23, thereby to detect abnormal convey of paper materials P. Further, this section 25 sends the results of detection to a display device 13 to display the results, and drives an alarm device 26 if necessary.

Otherwise, this detect processing may use image division processing according to the above first and embodiments.

Further, the section 25 is arranged so as to send such information as monitor section monitor signals 27 to a host control device 28, thereby to control the entire apparatus.

The detect processing section 25 is connected through a timing generate section 29 with a mark generate section 30 as a specific mark generating means. The mark generate section 30 generates a mark in a monitor area 9 when self-diagnosis for an image pick-up system is performed.

As a specific method of generating a mark in the mark generate section 30, for example, there is a method of using a mark M which can be electrically turned on/off like an LED (light emitting diode) or a method of making a mark M appear by mechanically opening/closing a shutter, as shown in FIG. 23. In this case, a change realized upon a mark generating instruction may be either ON/OFF (or "invisible" to "visible") or OFF/ON (or "visible" to "invisible").

As a method of generating a mark other than those described above, such a method which enables a change to locally occur can be used.

In addition, in case where a shutter is used as a mark, the shape which appears when the shutter returns back is explained as a circle in this example, but this shape is not limited to a circle in any cases.

Next, the processing for performing self-diagnosis as to whether or not an image pick-up system is regularly operating will be explained with reference to flow-charts shown in FIG. 24. Image input operation from an ITV camera 10 is started (S101), and a self-diagnosis time measurement counter is reset (S102). The detect processing section 25 performs time-based differentiate processing on consecutive images on the time-base, which are taken in by the image memory 23. A difference between two consecutive images in the image memory 23 is obtained (S103), and noise processing (S105) is performed on a result obtained by performing binarize processing (S104) on the result obtained above as the difference. Finally, whether or not concentrated change areas exist in an image is checked (S106). If such change areas exist, there is a possibility that the appa-

ratus is moving within a monitor area 9, and therefore, the flow returns to the differentiate processing in the step S103. The operation as described above is repeated.

With respect to noise reduction, it is possible to achieve noise reduction, for example, by eliminating isolated points from a binary image by means of compression and expansion processing.

If an abnormal state is not detected in the step S106, the detect processing section 25 makes a mark as described above generated in the monitor area 9 by sending a mark generate instruction to a mark generate section 30 through a timing generate section 29.

Then, the detect processing section 25 takes in an image in the monitor area 9 again (S108), and performs detect processing by a method of time-based difference using a plurality of images taken in by the image memory 23, like detection of convey abnormal state as described above, or by a method of image division detect processing as specifically explained above (S109), thereby to check whether or not a change due to a mark is detected (S110) after generation of a mark is instructed. If a mark is detected, the image pick-up system is determined as normally operating, and the state that the system is normally operating is displayed on the display device 13 (S111). Then, the mark generate instruction is released (S115).

If a mark is not detected in the step S110, the contents of the self diagnosis time measurement counter is updated by "+1" (S112), and thereafter, whether or not the contents of the counter is larger than a predetermined value previously set is determined (S113). If the contents is smaller than the predetermined value, the flow returns to the image take-in processing in the step S108, and the same operation as described above is repeated.

In the step S113, if the contents of the counter is larger than the predetermined value, it is determined that there is a defective in an input from the image pick-up system (S114), and the state that a defective exists in an input is displayed on the display device 13. Then, the flow goes to the step S115 and releases the mark generate instruction.

Specifically, if generation of a mark cannot be detected when a predetermined time has passed since a instruction of generating a mark was supplied, it is determined that there is a defective in an input from the image pick-up system and a notification is supplied. If a mark is detected within the predetermined time, it is determined that the image pick-up system is normally operating and a notification is supplied. The successive processing is then continued.

FIG. 25 is a block diagram of an example of a structure mainly showing a processing device 12 according to a fourth embodiment of the present invention. This embodiment explains a case of comprising a self-diagnosis function for a detect function of the image pick-up system, and differs from the third embodiment in that a false abnormal state generate section 31 is provided in

place of a mark generate section 30 in the third embodiment of FIG. 21.

Specifically, the false abnormal state generate section 31 generates a false abnormal state within a monitor area 9 when self-diagnosis for the detect function is performed. As a specific generate method of generating a false abnormal state in the false abnormal state generate section 31, for example, there is a method in which a false object 43 similar to a paper material P to be actually conveyed is installed at an end portion of an arm 42 rotated around a shaft 41 as a fulcrum, as shown in FIG. 26, and the arm 42 is rotated so as to insert the false object 43 into the monitor area 9 when a generation instruction is supplied, thus generating a false abnormal state.

In the above example, explanation has been made to a method in which a false object 43 is installed on an end portion of the arm 42. However, it is possible to use another method than the method described above, as long as such a method can generate a false abnormal state.

In the next, explanation will be made to processing for performing self-diagnosis as to whether or not the detect function is normally operating (i.e., whether or not an abnormal state occurring in a monitor area 9 can be correctly detected in this case), with reference to flowcharts shown in FIG. 27. Image input operation from the ITV camera 10 is started (S121), and the self-diagnosis time measurement counter is reset (S122).

Then, the detect processing section 25 performs time-based differentiate processing on consecutive images on the time-base, which are taken in by the image memory 23. A difference between two consecutive images in the image memory 23 is obtained (S123), and noise processing (S125) is performed on a result obtained by performing binarize processing (S124) on the result obtained above as the difference. Finally, whether or not concentrated change areas exist in an image is checked (S126). If such change areas exist, there is a possibility that the apparatus is moving within a monitor area 9, and therefore, the flow returns to the differentiate processing in the step S103. The operation as described above is repeated.

With respect to noise reduction, it is possible to achieve noise reduction, for example, by eliminating isolated points from a binary image by means of compression and expansion processing.

If an abnormal state exists in the monitor area 9 (S126), the flow returns to image take-in processing in the step S123, and the same processing as above is repeated.

If an abnormal state is not detected in the step 126, the detect processing section sends a false abnormal state generate instruction to a false abnormal state generate section 31 through a timing generate section 29 (S127), thereby to make a false abnormal state generated in the monitor area 9, as described above.

Then, the detect processing section 25 takes in an image in the monitor area 9 again (S128), and performs detect processing by a method of time-based difference

using a plurality of images taken in by the image memory 23, like detection of convey abnormal state as described above, or by a method of image division detect processing as specifically explained above (S129), thereby to check whether or not an abnormal state is detected (S130) after generation of an abnormal state is instructed. If an abnormal state is detected, the detect function is determined as normally operating, and the state that this function is normally operating is displayed on the display device 13 (S131). Then, the abnormal state generate instruction is released (S132).

If an abnormal state is not detected in the step S130, the contents of the self diagnosis time measurement counter is updated by "+1" (S133), and thereafter, whether or not the contents of the counter is larger than a predetermined value previously set is determined (S134). If the contents is smaller than the predetermined value, the flow returns to the image take-in processing in the step S128, and the same operation as described above is repeated.

In the step S134, if the contents of the counter is larger than the predetermined value, it is determined that there is a defective in the detect function or that there is a defective in an input from the image pick-up system, and the state that there is a defective is displayed on the display device 13 (S135). Then, the flow goes to the step S132 and releases the abnormal state generate instruction.

Specifically, if an abnormal state cannot be detected when a predetermined time has passed since a instruction of generating an abnormal state was supplied, it is determined that there is a defective in the detect function or that there is a defective in an input from the image pick-up system and a notification is supplied. If an abnormal state is detected within the predetermined time, it is determined that the detect function is normally operating and a notification is supplied. The successive processing is then continued.

In the next, a fifth embodiment of the present invention will be explained below. This embodiment explains a case of comprising an automatic setting function of a monitor area 9.

FIG. 28 shows four marks M1, M2, M3, and M4 placed in a monitor area 9 to be monitored according to the third embodiment shown in FIG. 20. This embodiment has an object of securely monitoring the area surrounded by the marks M1, M2, M3, and M4. In the following, the area surrounded by these marks will be referred to as a monitor area 9, and explanation will be made supposing that four marks are set.

When four marks M1, M2, M3, and M4 placed in the monitor area 9 are picked up and taken in as an image by an ITV camera 10, these marks are viewed in several different ways due to dislocations of the ITV camera 10 or the likes. For example, FIG. 29A shows a normal state in which the monitor area 9 is positioned substantially in the center of the camera view field. FIG. 29B shows a state in which the monitor area 9 is positioned within the camera view field, with being shifted from the center of

the view field. FIG. 29C shows an example in which the monitor area 9 is out of the camera view field, and in this case, it is difficult to carry out monitoring which will achieve the object of this embodiment.

In the following, the setting operation for setting a monitor area 9 will be explained with reference to flowcharts shown in FIGS. 30A and 30B. Image input operation from an ITV camera 10 is started (S141), and image data is taken in by the image memory 23 (S143). In this state, the number (i.e., "4" in this case) of marks used for setting a monitor area 9 is previously registered (S142).

Then, the detect processing section 25 performs processing for detecting marks by a method of time-based difference using a plurality of images taken in by the image memory 23, like detection of convey abnormal state as described above, or by a method of image division detect processing as specifically explained above (S144), thereby to calculate the number m of marks thus detected (S145). Then, the calculated number m is compared with the number n of marks previously set (S146, S147, and S148). If the number of detected marks is 3 or more, as a result of this comparison, it is possible to set a monitor area on the basis of these marks, and therefore, the area to be monitored is set on the basis of the positions of these marks.

Specifically, if the number of detected marks is 4, the detect positions are recorded (S149), and thereafter, the monitor area 9 is set on the basis of the respective positions of the four marks (S150). If the number of detected marks is 3, detected positions thereof are recorded, and thereafter, the position of a fourth mark is estimated on the basis of the respective positions of the three marks (S152). If the position of the fourth mark is estimated, the processing goes to the step S150 and sets a monitor area 9 is set.

Otherwise, if the number of detected marks is 2 or less (although at least three or more marks are necessary), it is not possible to set an area except for several specific cases. In this case, it is therefore considered that the image pick-up system cannot grasp marks, and an instruction for correcting the setting of the image pick-up system is supplied.

Specifically, if the number of detected marks is 2, whether or not the two marks are corners on the diagonal line of a monitor area is determined (S153). If yes, the detected positions thereof are recorded (S154), and thereafter, positions two other remaining marks are estimated on the basis of the respective positions of the two marks (S155). If those positions are estimated, the processing goes to the step S150 and a monitor area 9 is set.

In addition, if the number of detected marks is 2 or less, it is determined that the image pick-up system is abnormal (S156), and a notification indicating that setting of a monitor area is impossible is displayed on the display device 13 (S157). Further, if detected two marks are not two corners on a diagonal line, in the step S153, the processing goes to the step S157, and a message

indicating that setting of a monitor area is impossible is displayed.

Although the above explanation has been made to a case where a monitor area is set by supposing that the number of marks is four, the number of marks is not especially limited as long as the number of marks is 2 or more. In addition, it is possible to use the mark explained in the third embodiment described above, as an example of marks.

As has been explained above, according to the first embodiment of the present invention, processing with use of information concerning the entire of an image is not performed, but an image is divided into a plurality of areas, and processing using characteristic amounts in respective areas is performed. Besides, analysis is performed on the time-based changes in the characteristic amounts. By thus roughly dividing an image intentionally, it is possible to absorb small changes such as vibration and the like, and to concentrate to extraction of only large changes (such as a movement of an object in an image), so that changes in an image, occurrence of an abnormal state, and the likes can be extracted without making comparison with templates.

In addition, it is possible to absorb influences from vibration of an ITV camera or the like, in the step of dividing an image into a plurality of areas, so that processing such as noise reduction is not required.

According to the second embodiment, it is possible to perform fine detection of an abnormal state and abnormal state detect processing at a high processing speed, by further dividing the divided areas or by fusing the divided areas with each other.

In addition, according to the third and fourth embodiments as described above, it is possible to absorb a large or small shift of the installation position of an ITV camera and to notify a system manager of the portion where a defective occurs on the basis of a diagnosis result, by comprising a self-diagnosis function of confirming that an image pick-up system or a detection function is normally operating. Therefore, labor for inspections and adjustment services can be greatly reduced.

According to the fifth embodiment, the monitor area as a target can be automatically corrected, and therefore, erroneous detection is not easily caused even when the orientation of an ITV camera is more or less changed.

## Claims

1. An image data processing apparatus characterized by comprising:
  - means (10, 21, S2) for continuously receiving a image of a first area (FIG. 3, (a)) to be processed, and for converting the image into a first image data item;
  - means (25, 23, S3) for dividing the first image data into a plurality of second image data items corresponding to a plurality of second areas (FIG. 3, (b)) which are smaller than the first area; and

means (23, 24, 25, S4) for performing predetermined processing for each of the second image data items so as to determine an abnormal state in the first area.

2. An apparatus according to claim 1, characterized in that the detecting means includes means (23, 24, 25, and S4) for detecting a time-based change in a characteristic amount of the image for each of the second image data items.
3. An apparatus according to claim 1, characterized in that the detecting means includes means (23, 24, 25, and S4) for detecting a time-based change in an average density amount of the image for each of the second image data items.
4. An apparatus according to claim 1, characterized in that the detecting means includes means (23, 24, 25, and S4) for detecting a time-based change in a density dispersion value of the image for each of the second image data items.
5. An apparatus according to claim 1, characterized in that the detecting means includes means (23, 24, 25, and S4) for detecting a time-based change in randomness obtained as a result of differential binarization of the image for each of the second image data items.
6. An apparatus according to claim 1, characterized in that the detecting means includes means (23, 24, 25, and S4) for detecting a time-based change in a hue amount of a color image for each of the second image data items.
7. An apparatus according to claim 1, characterized in that the detecting means includes means (23, 24, 25, and S4) for detecting a time-based change in chroma of a color image for each of the second image data items.
8. An apparatus according to claim 1, characterized in that the detecting means includes means (23, 24, 25, and S4) for detecting a time-based change in brightness of a color image for each of the second image data items.
9. An apparatus according to claim 1, characterized in that the detecting means includes means (23, 24, 25, and S4) for detecting a time-based change amount in a characteristic amount of the image for each of the second image data items, for determining abnormality of the second image data items on the basis of the change amount; and means for determining that the first area is in an abnormal state if the number of such adjacent items among the second data items which are determined

as being abnormal is equal to or more than a predetermined amount.

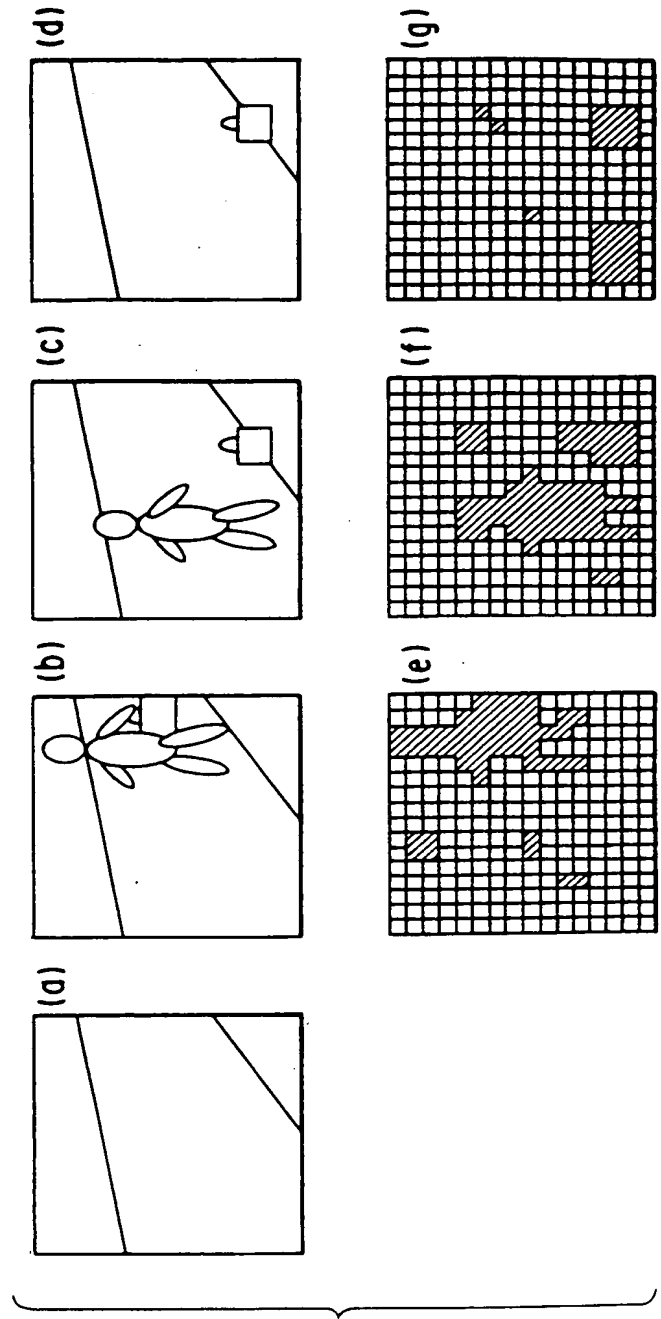
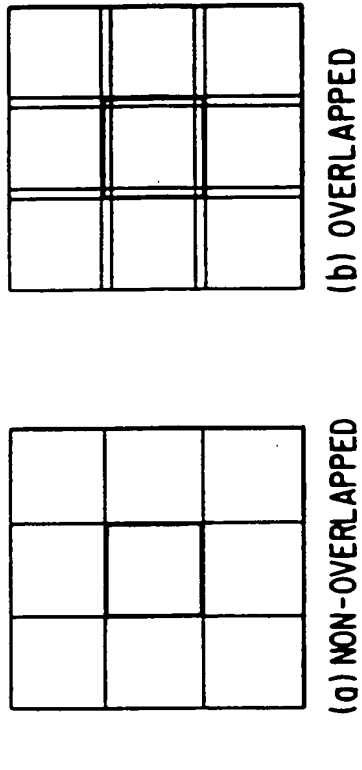
10. An image data processing apparatus according to claim 1, characterized in that the performing means includes;
  - first detecting means (23, 24, 25, S4) for detecting a time-based change amount in a characteristic amount for each of the second image data items;
  - first finding means (S31 to S34) for finding unstable image data items from the second image data items, the unstable image data items have the time-based change amount in the characteristics remaining to or less than a first predetermined value, and have an occurrence frequency of changes exceeding a predetermined number of times for a first predetermined period or more;
  - second dividing means (S31 to S34) for dividing the first image data item so as to form third image data items by dividing the unstable image data items when the first finding means finds the unstable image data items;
  - second detecting means (S4) for detecting a time-based change amount in a characteristic amount for the third image data items;
  - second finding means (S31 to S34) for finding plain image data item from the second image data items, the plain image data items are adjacent to each other and which have the time-based change amount in the characteristics remaining equal to or less than a second predetermined value for a second predetermined period or more;
  - third dividing means (S31 to S34) for dividing the first image data item so as to form fourth image data items by fusing the plain image data items when the second finding means finds the plain image data items;
  - third detect means (S4) for detecting a time-based change amount in a characteristic amount for the third image data items; and
  - means for determining an abnormal state of the first area on the basis of the change amounts detected by the first, second, and third detecting means.
11. An apparatus according to claim 10, characterized by further comprising:
  - means (29, 30, and S107) for generating a recognizable mark in the first area at a predetermined timing; and
  - means (29, 30, and S108 to S111) for detecting the mark generated by the generating means so as to determine that an inverting function of the image data processing apparatus regularly operates.
12. An apparatus according to claim 10, characterized by further comprising:

means (29, 30, and S107) for generating an abnormal state in the first area at a predetermined timing; and

means (29, 30, and S110 and S111) for detecting the abnormal state generated by the generating means so as to determine that an abnormal detection function of the image data processing apparatus regularly operates.

13. An apparatus according to claim 10, characterized by further comprising:
  - means (29, 30, and S107) for generating a plurality of marks indicating a range of an area to be monitored, in the first area at a predetermined timing; and
  - means (23, 24, 25, S110, and S111) for detecting the marks generated by the generating means so as to determine that an inverting function of the image data processing apparatus regularly operates.
14. An image data processing method characterized by comprising the steps of:
  - continuously receiving a image of a first area (FIG. 3, (a)) to be processed, and converting the image into a first image data item (S2);
  - dividing the first image data item into a plurality of second image data items corresponding to a plurality of second areas (FIG. 3, (b)) which are smaller than the first area; and
  - determining an abnormal state in the first area, by performing predetermined processing for each of the second image data items.
15. An image data processing method according to claim 14, characterized in that the determining step includes a step of detecting a time-based change amount in a characteristic amount of the image for each of the second image data items, and of determining an abnormal state in the first area on the basis of the change amount.
16. An image data processing method according to claim 14, characterized by further comprising the steps of;
  - finding (S31 to S34) unstable image data items from the second image data items, the unstable image data items have the time-based change amount in the characteristics remaining to or less than a predetermined value, and have an occurrence frequency of changes exceeding a predetermined number of times for a predetermined period or more;
  - a second dividing step (S31 to S34) of dividing the first image data item so as to form third image data items by dividing the unstable image data items when the finding step finds the unstable image data items;
  - a detecting step (S29) of detecting a time-

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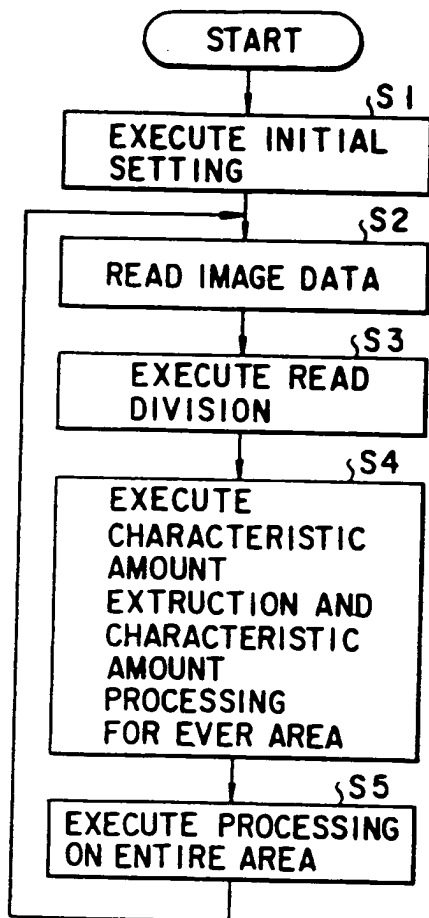


FIG. 7

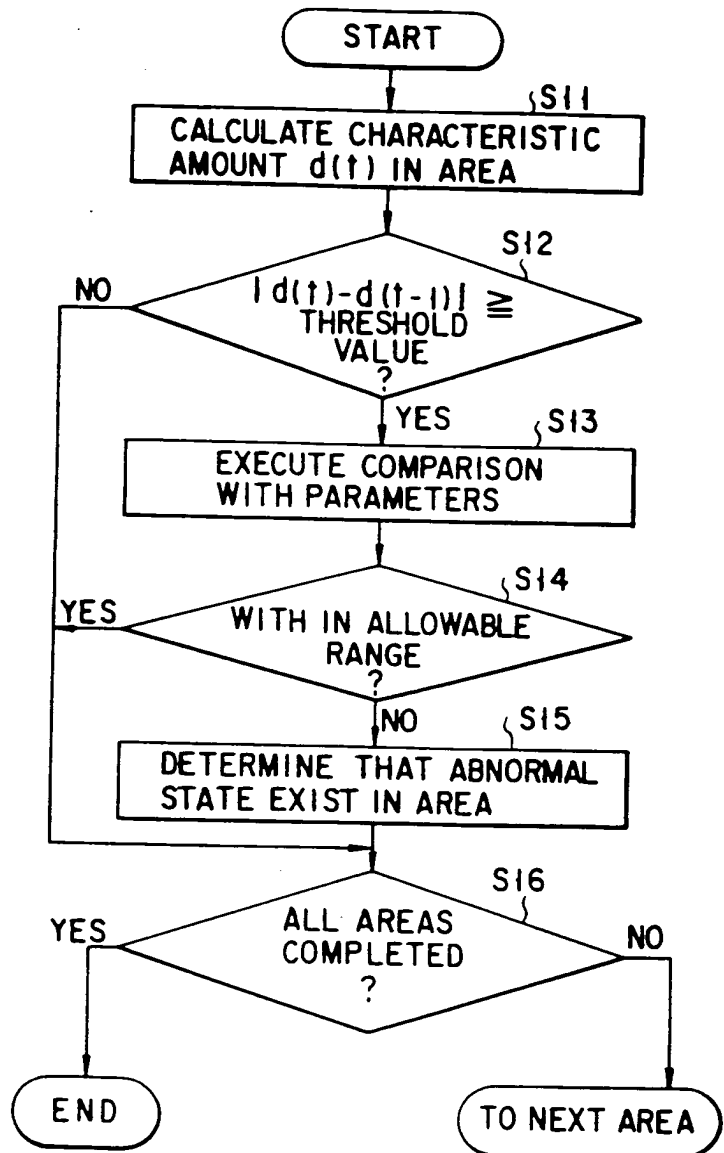


FIG. 8

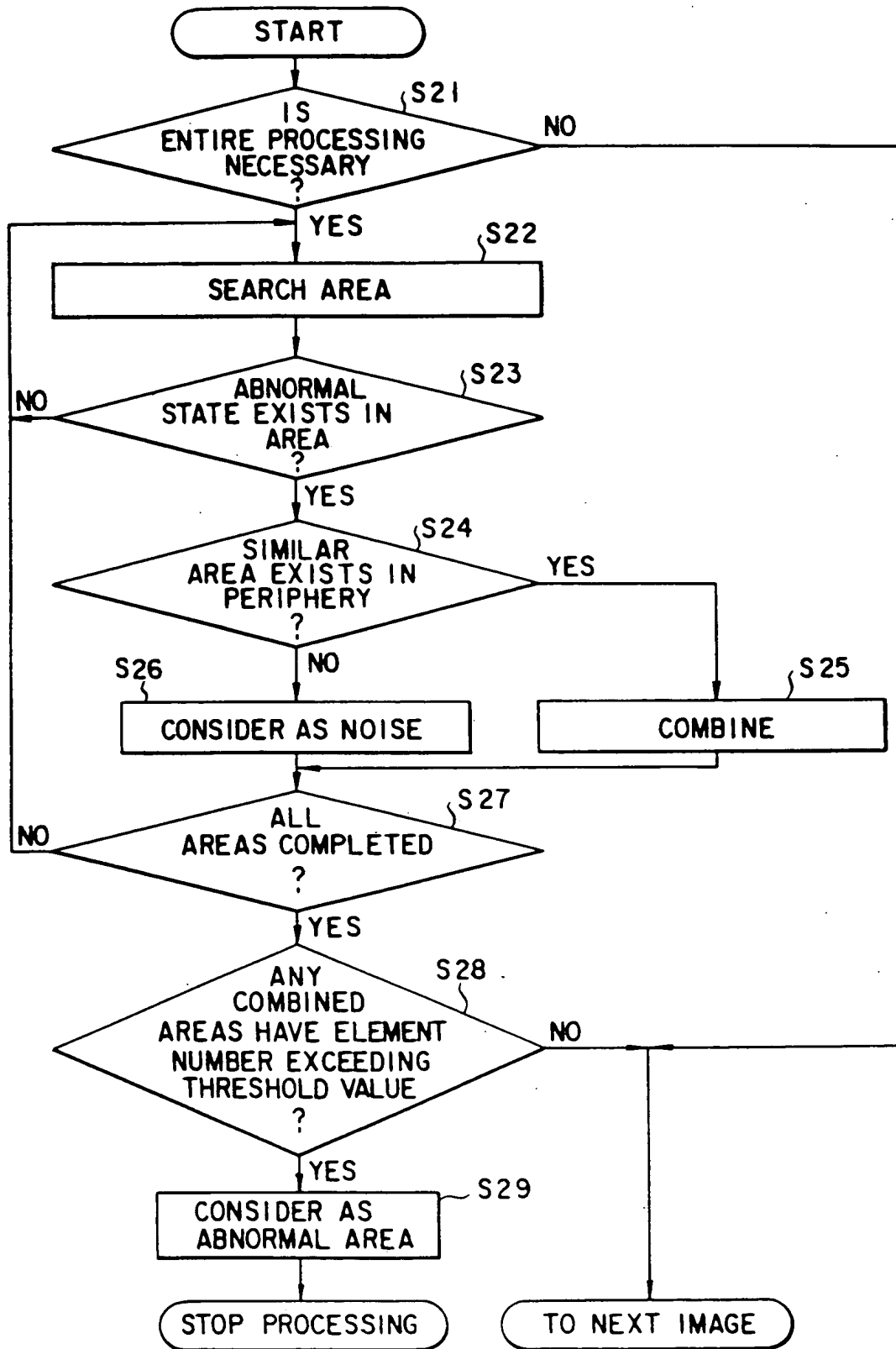


FIG. 9

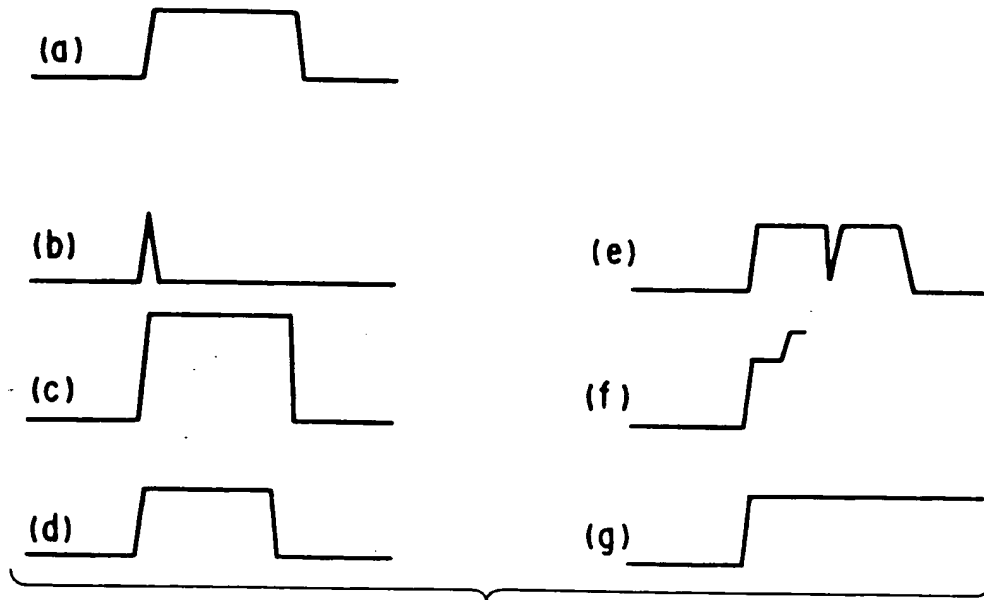


FIG. 10

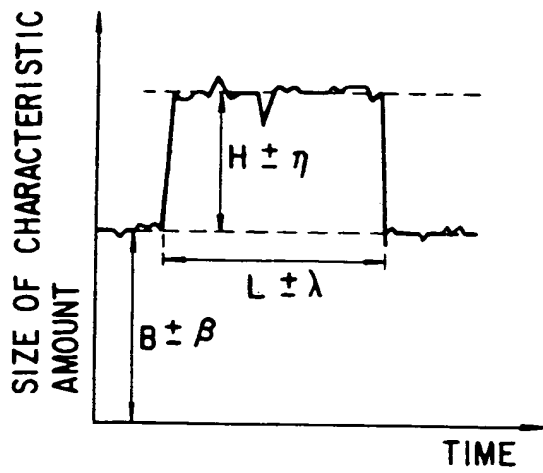


FIG. 11A

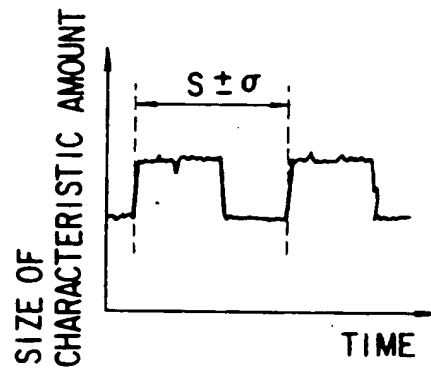


FIG. 11B

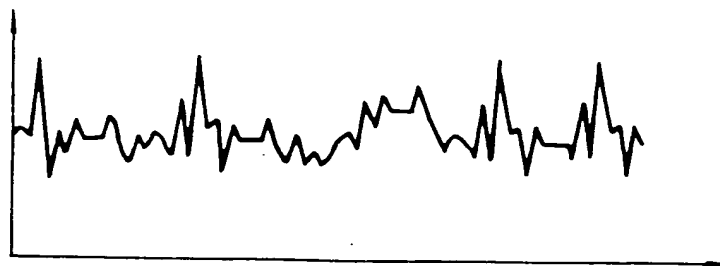


FIG. 13

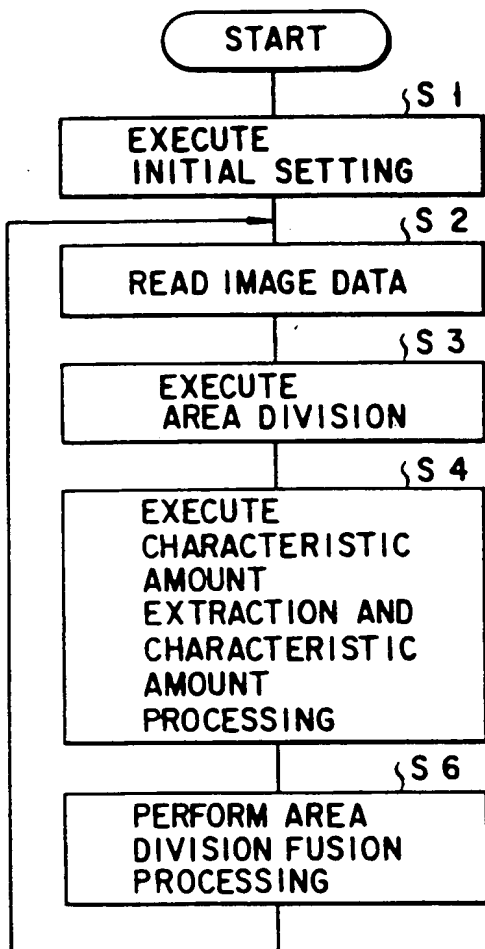


FIG. 12

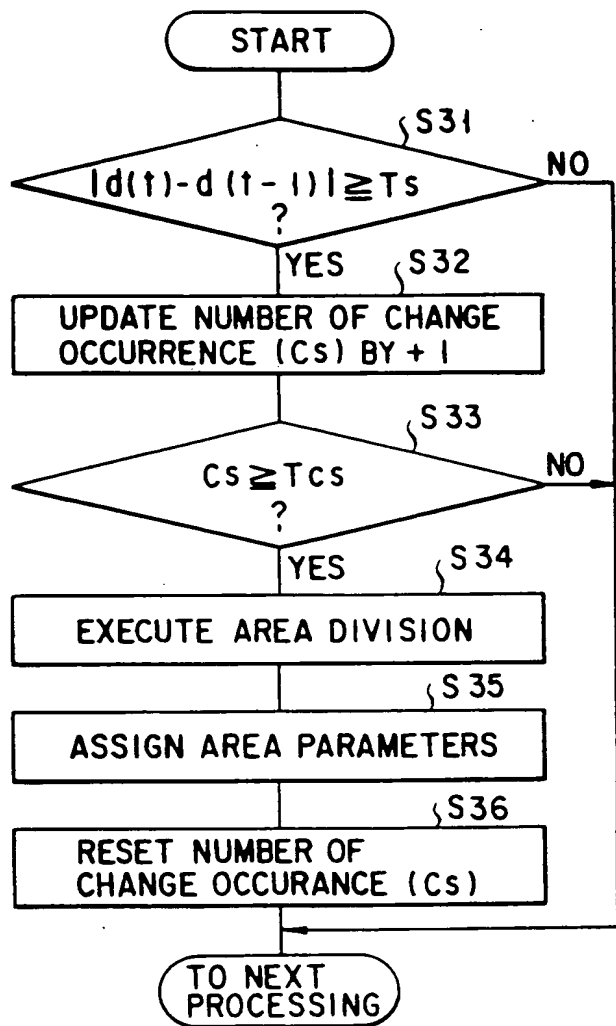


FIG. 17

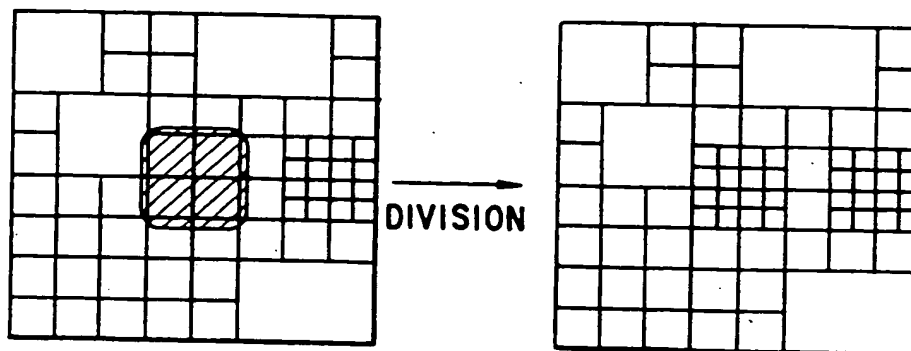


FIG. 14

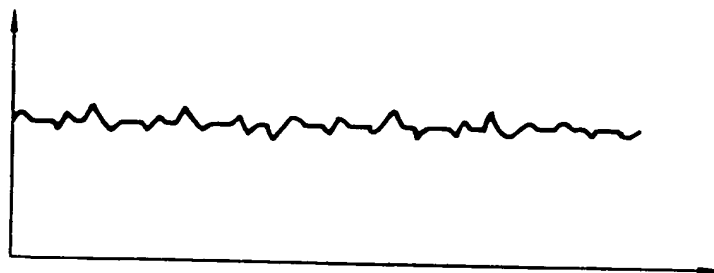


FIG. 15

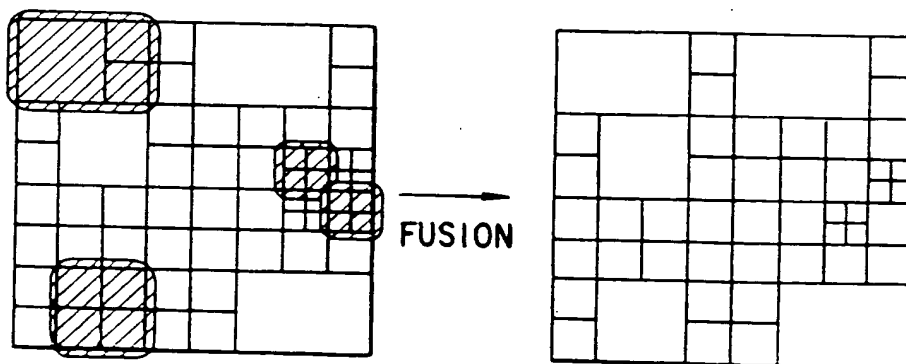


FIG. 16

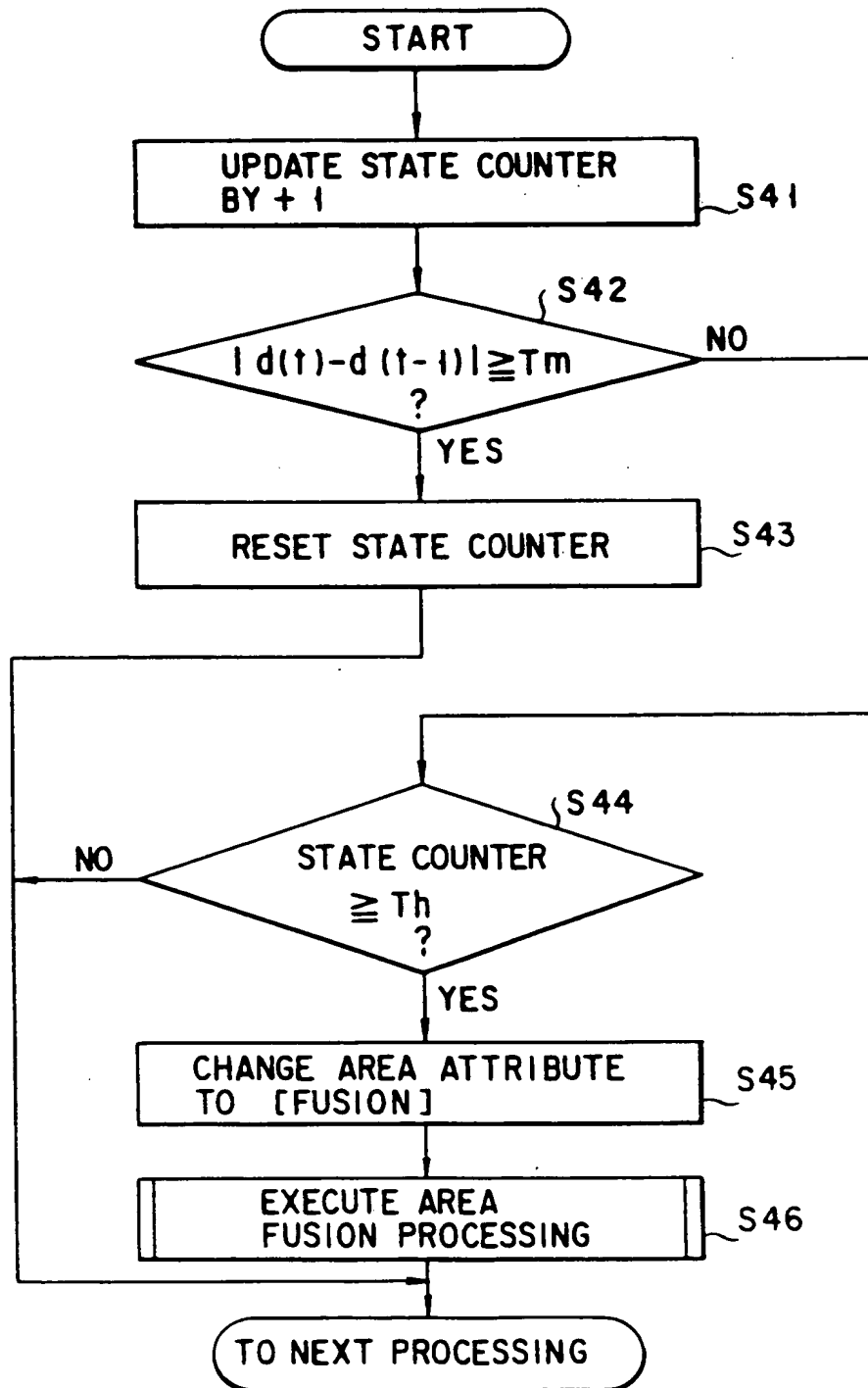


FIG. 18

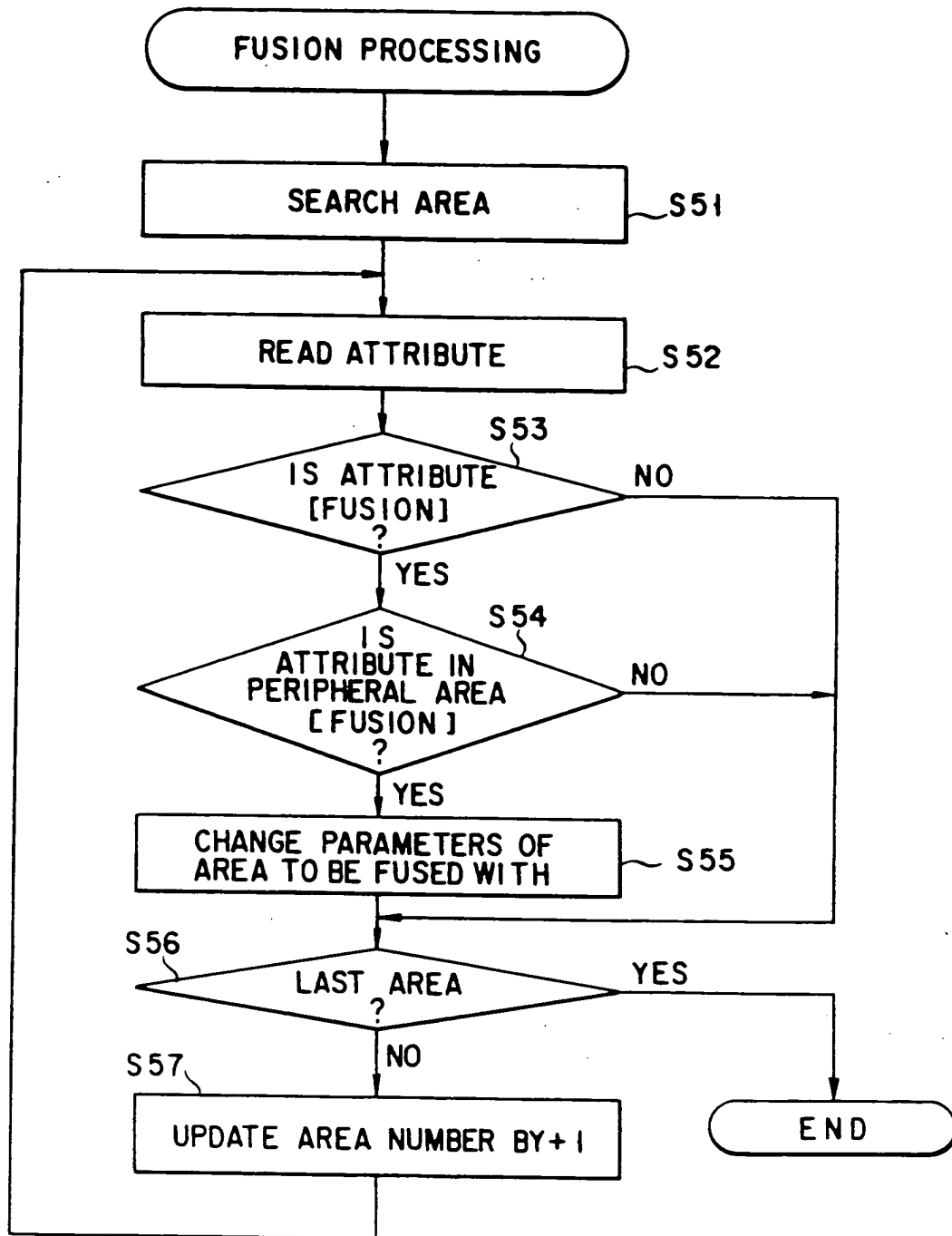
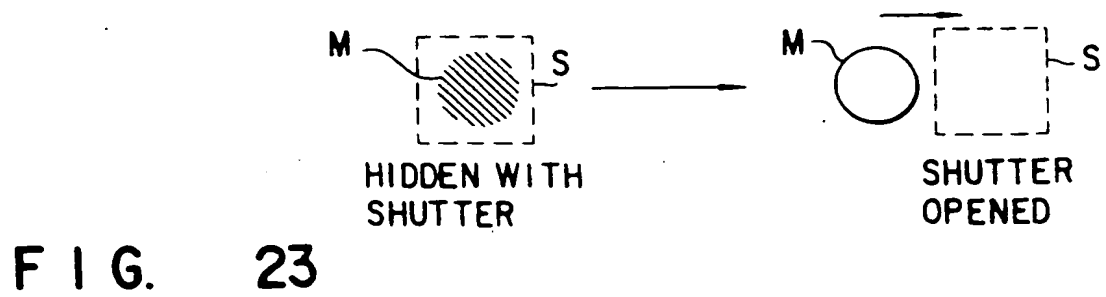
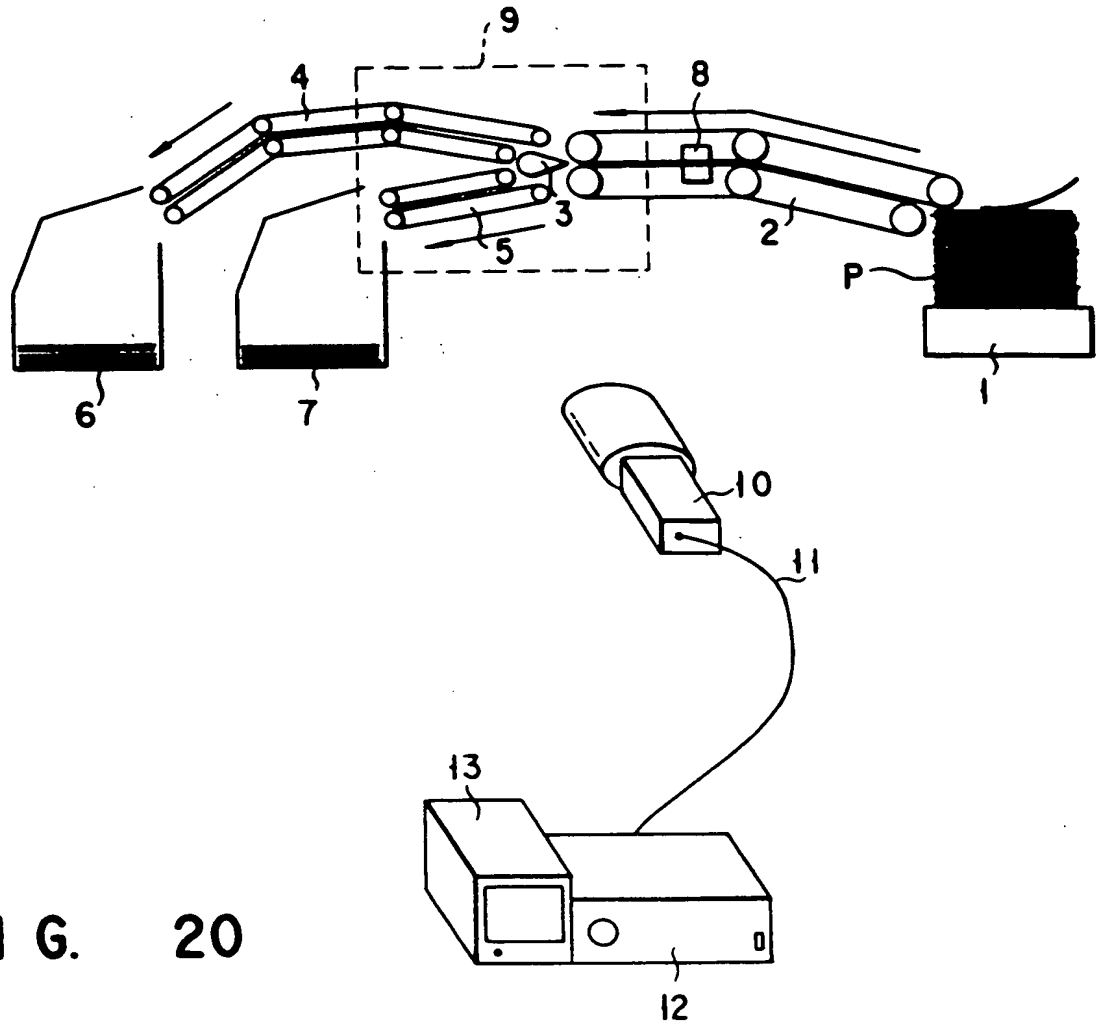


FIG. 19



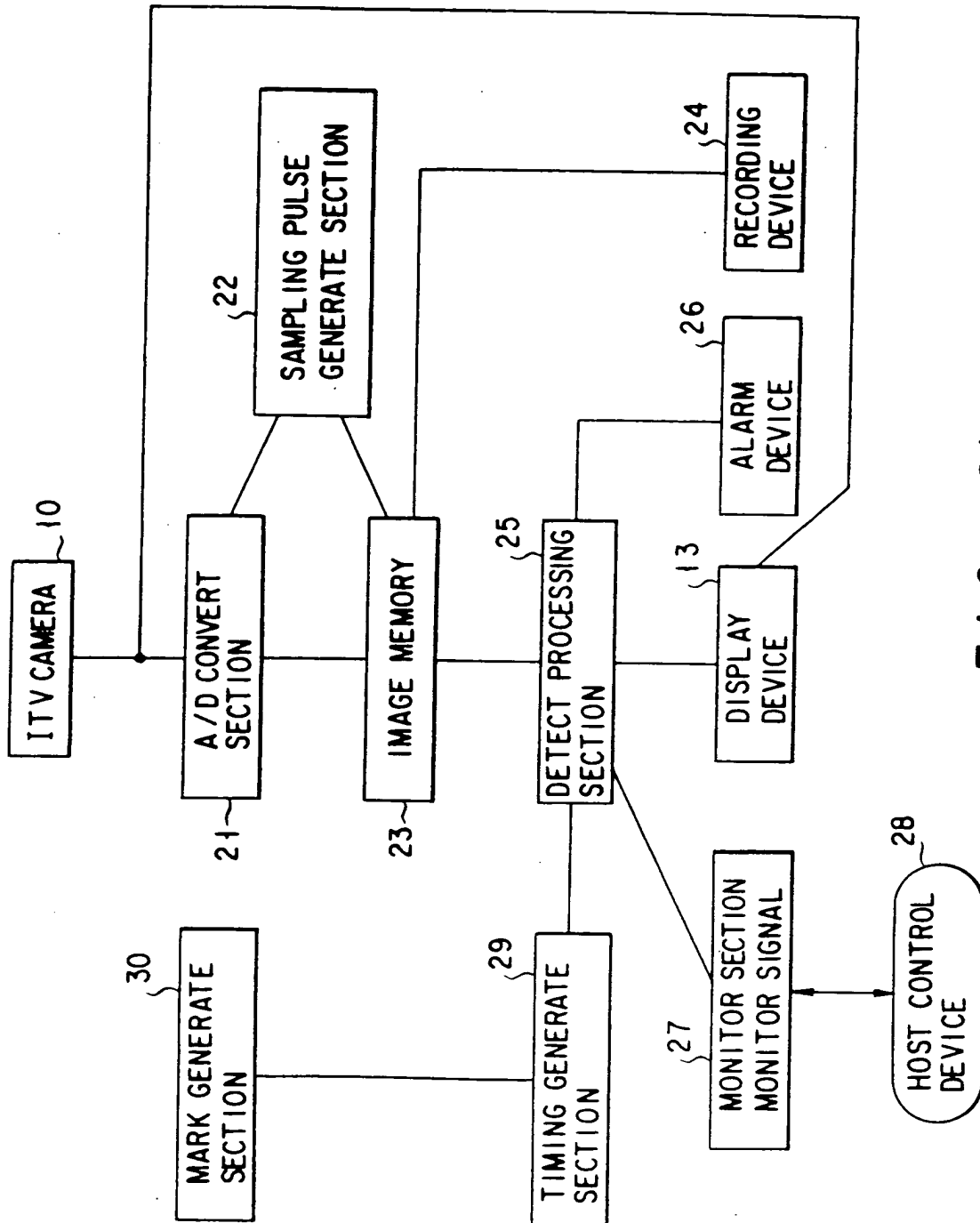


FIG. 21

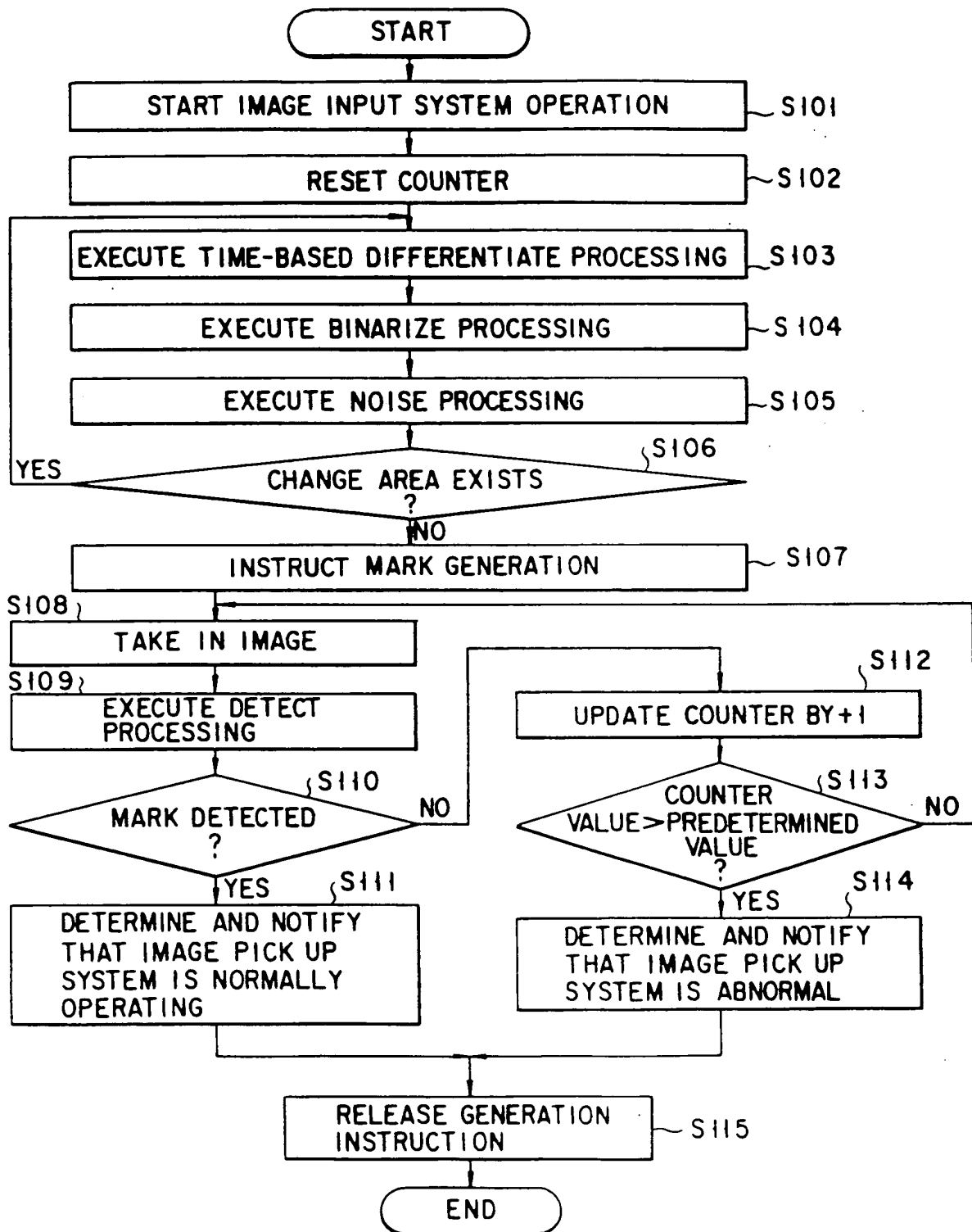


FIG. 24

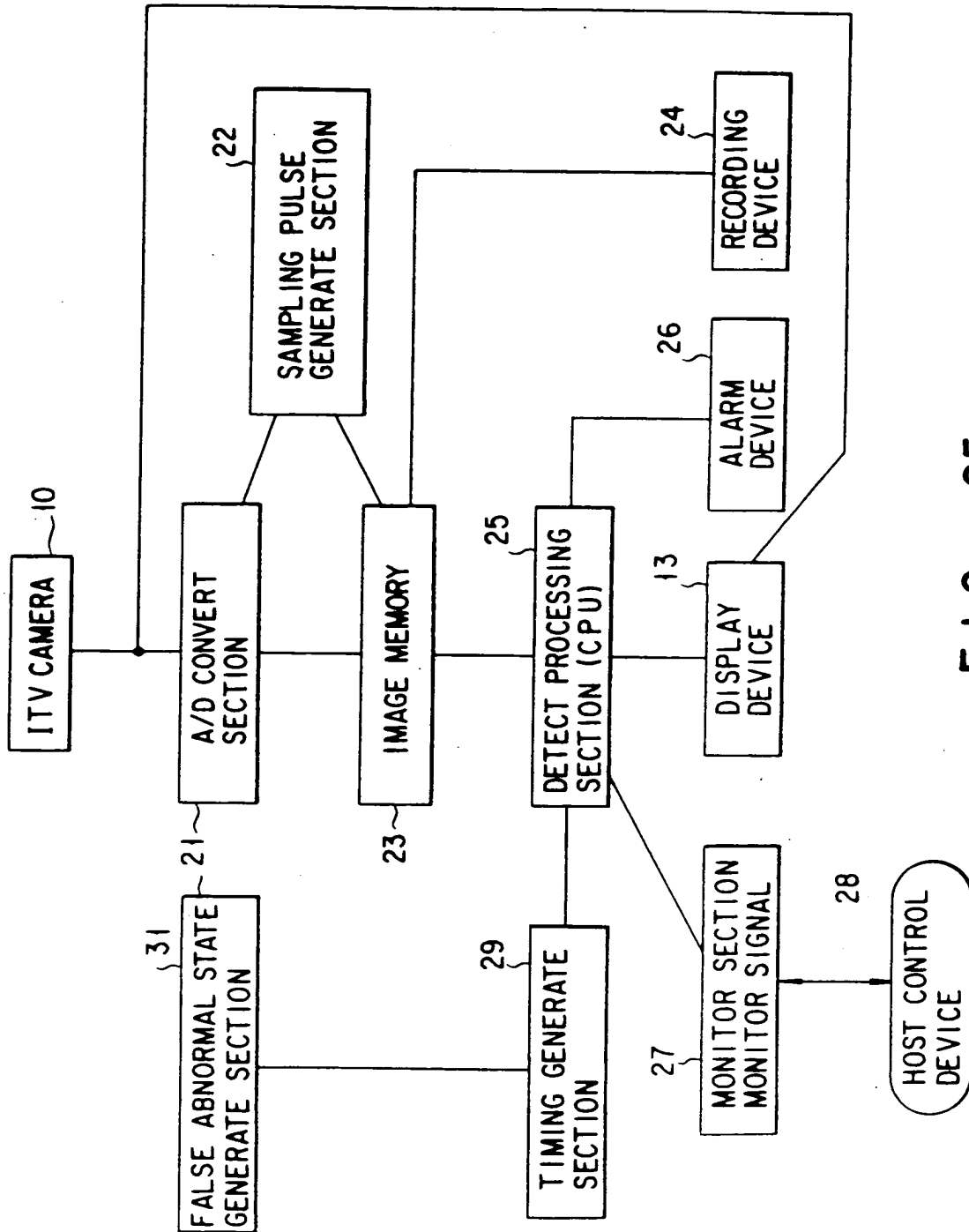


FIG. 25

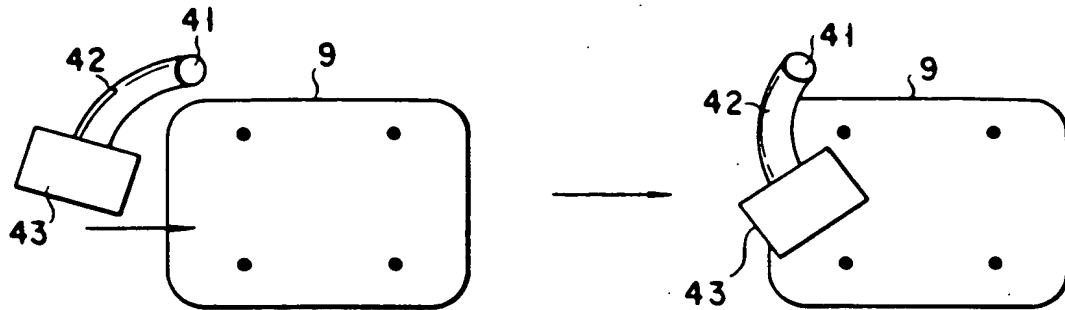


FIG. 26

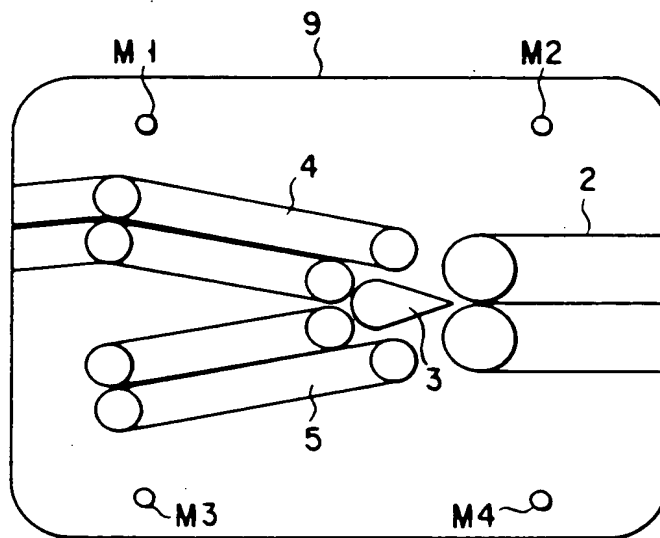
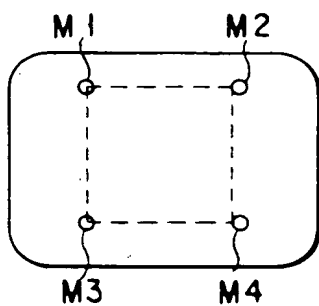
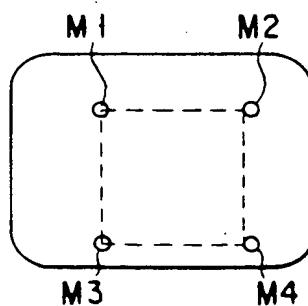


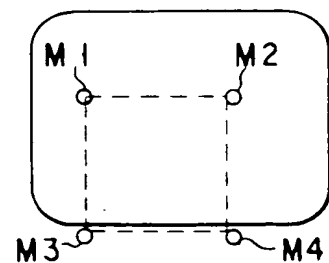
FIG. 28



MARKS ARE  
AT PROPER  
POSITION



MARKS ARE  
SHIFTED WITHIN  
ALLOWABLE RANGE



MARKS ARE  
OUT OF IMAGE  
PICK UP RANGE

FIG. 29A

FIG. 29B

FIG. 29C

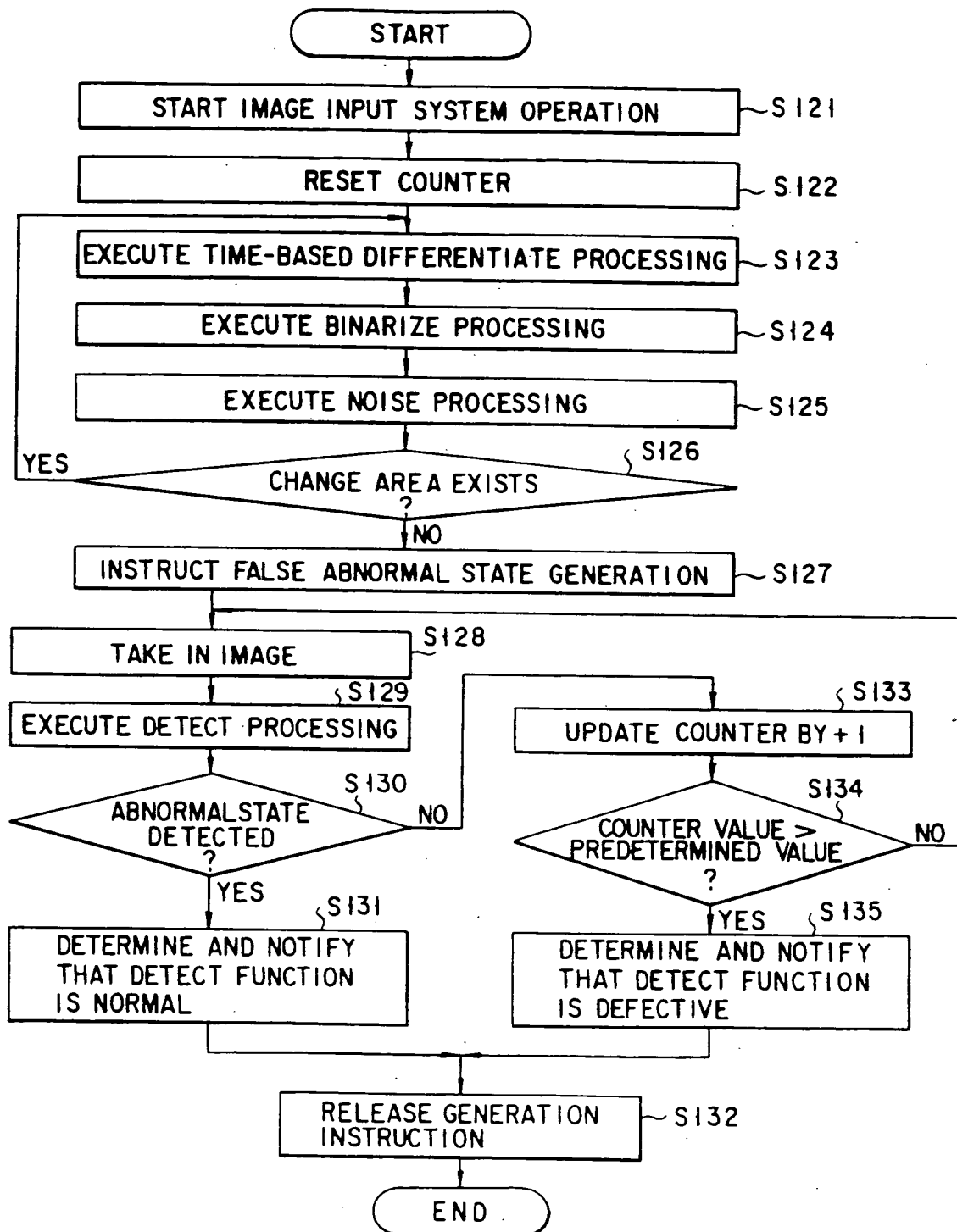


FIG. 27

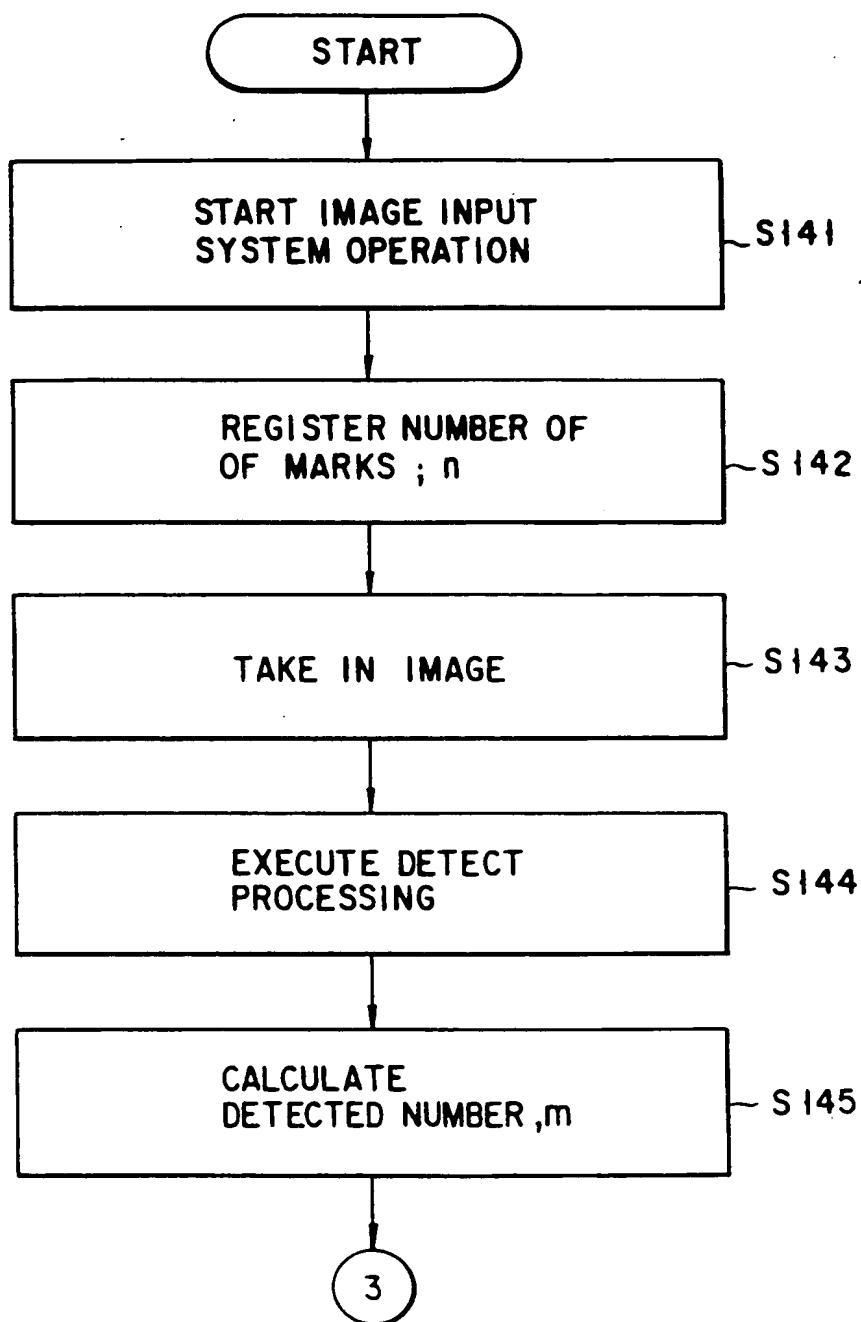


FIG. 30A

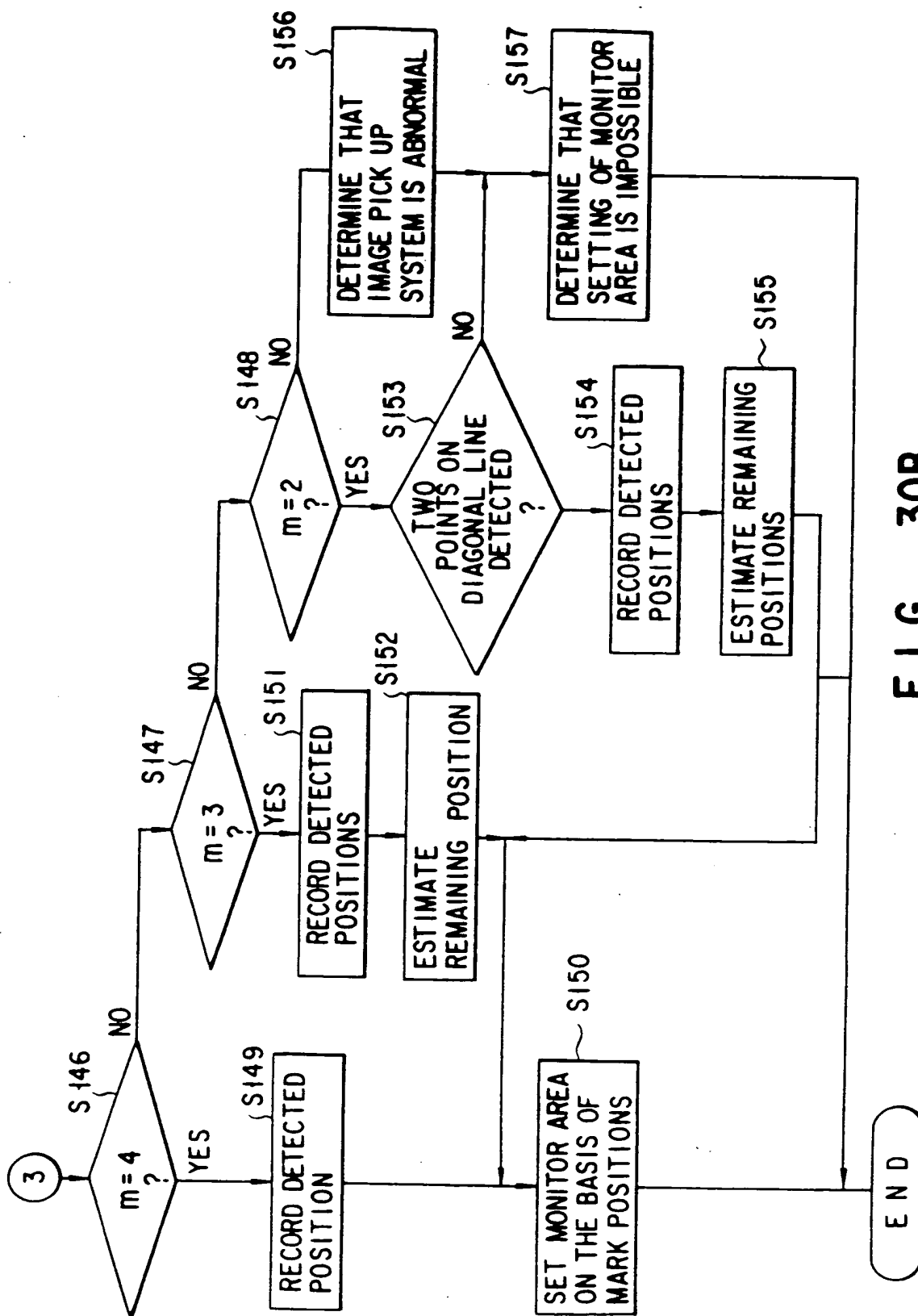


FIG. 30B



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 95 11 4585

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X A	EP-A-0 528 105 (PIONEER ELECTRONIC CORP) 24 February 1993  * page 3, column 3, line 49 - page 8, column 13, line 6 * * figures 1-6 *	1-7, 9, 14-17 8, 10-13	H04N7/18
X A	EP-A-0 604 009 (IBM) 29 June 1994  * page 3, column 3, line 1 - column 4, line 35 * * page 4, column 5, line 16 - page 6, column 9, line 51 * * figures 1-6 *	1-5, 9, 14-17 10-13	
A	SIGNAL + DRAHT, vol. 84, no. 9, 1 September 1992 pages 264-268, XP 000345146 HABER H J 'UEBERWACHUNG MIT DIGITALER BILDEBERTRAGUNG' * the whole document *	1-17	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	US-A-5 339 104 (HONG SAM P) 16 August 1994 * column 2, line 36 - column 3, line 23 * * column 4, line 4 - line 50 * * figure 2 *	1-17	H04N
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 11 December 1995	Examiner Van der Zaal, R
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>			

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